PCT/AU

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference EXPL/20102184/KC/twm	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. PCT/SG02/00009	International Filing Date *(day/month/year)* 22 January 2002	Priority Date *(day/month/year)* 22 January 2002
International Patent Classification (IPC) or national classification and IPC Int. Cl.[7] G06T 5/50		
Applicant NATIONAL UNIVERSITY OF SINGAPORE et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   [X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheet(s).

3. This report contains indications relating to the following items:

   - I [X] Basis of the report
   - II [ ] Priority
   - III [ ] Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV [ ] Lack of unity of invention
   - V [X] Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI [ ] Certain documents cited
   - VII [ ] Certain defects in the international application
   - VIII [ ] Certain observations on the international application

Date of submission of the demand	Date of completion of the report
5 May 2003	9 October 2003
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **ROBERT BARTRAM** Telephone No. (02) 6283 2215

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SG02/00009

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed.

☒ the description, pages **1 to 10,** as originally filed,
pages , filed with the demand,
pages , received on with the letter of

☒ the claims, pages , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages **11 and 12** , received on **23 September 2003** with the letter of **23 September 2003**

☒ the drawings, pages **1/1,** as originally filed,
pages , filed with the demand,
pages , received on with the letter of

☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the **language,** all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1 to 15	YES
	Claims	NO
Inventive step (IS)	Claims 1 to 15	YES
	Claims	NO
Industrial applicability (IA)	Claims 1 to 15	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

D1) Simpson J. et al, IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, "A Procedure for the detection and removal of Cloud Shadow from AVHRR Data over Land", Vol, 36, No. 3, May 1998. See page 880 to 884 and Appendix I

D2) Varyguin D. et.al, "ADVANCES IN LAND COVER CLASSIFICATION FOR APPLICATIONS RESEARCH: A CASE STUDY FROM THE MID-ATLANTIC RESAC", Last modified 1 February 2001, Retrieved from the Internet on 8 April 2002 at <URL:*www.geog.umd.edu/resac/pdf/ASPRS_2001_LC.pdf*,.

D3) FR 2581494 A (SOCIETE EUROPEENE DE PROPULSION), 7 November 1986, See page 1 line 15 to page 3 line 17, the figures 1 and 2 and the abstract.

D4) Simpson J. et al ; REMOTE SENOR ENVIRONMENT, "Improved cloud detection in daytime AVHRR scenes over land" Vol. 55, no. 1, pp 21-49, 1996.

D4 is a reference listed in D1 and is included to show that cloud detection in D1 is disclosed as D4 is a direct reference in D1 rendering them as being read as one document and hence the feature of detecting clouds is clearly disclosed in D1. D4 was not raised in the first written opinion and is only raised here to show that cloud detection and cloud shadow detection are covered in D1 when read with D4.

Novelty and Inventive step: Claims 1 to 15.

No single document or any obvious combination of these documents disclose all of the features defined in any of the claims 1 to 15. In particular the feature of generating cloud free and cloud-shadow free images from a plurality of images wherein a conditional majority filter is used to include as large a patch of neighbouring good pixels as possible of a given location that come from the same image. As these documents do not teach this feature these claims are considered to be novel and inventive.

Industrial Applicability: Claims 1 to 15

These claims are clearly industrially applicable in the field of satellite remote sensing images.

The Claims

1. A method for generating a cloud free and cloud-shadow free image from a plurality of images of a region, the method including the steps of:

(a) ranking pixels in order of cloudiness and shallowness;

(b) using a conditional majority filter on the plurality of images of the region to include as large a patch of neighbouring good pixels from each of the plurality of images as possible;

(c) generating cloud and shadow masks by classifying a group of pixels as cloud, shadow, or noncloud-nonshadow; and

(d) creating a mosaic from the plurality of images to form the cloud free and cloud-shadow free image.

2. A method as claimed in claim 1, wherein each pixel in each of the images is ranked according to predefined ranking criteria, and the highest ranked pixels are used to compose the mosaic.

3. A method as claimed in claim 1 or claim 2, wherein size and shape information of bright pixel clusters are used to discriminate any bright land surfaces and buildings from clouds.

4. A method as claimed in any one of claims 1 to 3, wherein solar illumination direction, sensor viewing direction and typical cloud heights information is used to predict likely locations of cloud shadows.

5. A method as claimed in any one of claims 1 to 4, wherein intensity gradients are used to search for locations of cloud shadows near cloud edges.

6. A method as claimed in claim 5, further including the step of applying a morphological filter to the cloud masks detected by the intensity gradients to locate and include thin clouds around the edges of thick clouds.

7. A method as claimed in any one of claims 1 to 6, wherein the plurality of images is panchromatic satellite images.

8. A method as claimed in any one of claims 1 to 6, wherein the plurality of images is multi-spectral images.

9. A method as claimed in any one of claims 1 to 8, wherein the highest raking pixels are considered as good pixels and the lowest ranking pixels are considered as bad pixels.

10. A method as claimed in claim 9, wherein the good pixels are further classified into vegetation pixels and building pixels.

11. A method as claimed in claim 10, wherein the building pixels include land clearings.

12. A method as claimed in claim 10 or claim 11, wherein the classification depends on whether the pixel intensity is below or above a threshold for vegetation pixels.

13. A method as claimed in any one of claims 9 to 12, wherein darker good pixels are preferred over brighter good pixels.

14. A cloud free and cloud-shadow free image produced by the method of any one of claims 1 to 13.

15. A computer usable medium having a computer program code which is configured to cause a processor to execute one or more steps to enable a computer to perform the method of any one of claims 1 to 13.